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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/817,056	03/27/2001	Kai Yang	50432-067	9188

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EXAMINER

NGUYEN, THANH T

ART UNIT PAPER NUMBER

2813

DATE MAILED: 09/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/817,056	Applicant(s) OTA, KAZUYA	
	Examiner Thanh T. Nguyen	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 and 21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 6-12 is/are allowed.
- 6) ☒ Claim(s) 1-5, 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>13</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Request for Continued Examination

The request filed on 6/18/03 for a Request for Continued Examination (RCE) under 37 CFR 1.114 based on parent Application No. 09/817,056 is acceptable and a RCE has been established. An action on the RCE follows.

Information Disclosure Statement

The information disclosure statement filed on 3/11/03 has been considered.

Claim Rejections - 35 USC § 112

Claims 1-5, 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, line 7, the limitation "a bottom" should change to "a bottom of the first dielectric layer".

Claim 1 recites the limitation "the opening" in line 11. There is insufficient antecedent basis for this limitation in the claim. It is suggested to change to "the single opening".

Claim 1 recites the limitation "the first dielectric layer" in line 6-7, 15. There is insufficient antecedent basis for this limitation in the claim. It is suggested to change to "the single first dielectric layer".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 5, 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Inohara et al. (U.S. Patent No. 5,966,634).

Referring to figures 14-16, teaches a method of manufacturing a semiconductor device comprising:

Forming a single first dielectric layer (730) overlying a substrate (700);

Forming a first barrier layer (740), comprising a first dielectric barrier material (oxide) on the single first dielectric layer (730) with an interface therebetween;

Etching to form single opening (760, see figure 14) defined entirely by side surface of the first dielectric layer (730) and a bottom;

Forming a second barrier layer (765) comprising a second dielectric barrier material (silicon nitride) different from the first dielectric barrier material, on an upper surface of the first

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barrier layer (740) overlying the single dielectric layer (730), on the side surfaces of the single first dielectric layer (730) defining the single opening (760) and on the bottom of the opening (760);

Etching with selectivity to the first barrier layer (740), to remove the second barrier layer (765), and stopping on, the upper surface of the first barrier layer (740), and to remove the second barrier layer (765) from the bottom of the single opening (765), leaving a portion of the second barrier layer (765) as a liner (765) on the side surfaces of the first dielectric layer defining the single opening (760, see figure 16); and

Filling the single opening with metal to form a lower metal feature (see col. 5, lines 8-11).

With regarding to claim 5, filling the single opening with copper (Cu, see col. 5, lines 8-11).

With regarding to claim 21, etching to form the single opening (760) having entire side surface which are substantially parallel (see figure 14).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable Inohara et al. (U.S. Patent No. 5,966,634) previously applied to claims 1, 5, and 21 above, in view of Chooi et al. (U.S. Patent No. 6,284,657) and Chung et al. (U.S. Patent No. 6,017,817).

Inohara et al. teaches all of the limitations as described in claimed invention above. However, Inohara et al. does not teach forming a first and second dielectric barrier materials from the group consisting of silicon nitride, silicon oxynitride and silicon carbide by CVD process with thickness of about 50-500A°.

Chooi et al. depositing first barrier layer of silicon nitride (20, SiN) at a thickness of between 500-5,000 A° (see col. 5, lines 43-45) and second barrier layer of silicon carbide (15) at the thickness of between 50-5,000 A° (see col. 6, lines 23-33) by chemical vapor deposition (CVD, see col. 6, lines 23-33, meeting portion of claim 3).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form first barrier layer of silicon nitride at a thickness of between 500-5,000 A° and second barrier layer of silicon carbide at the thickness of between 50-5,000 A° by chemical vapor deposition in process of Inohara et al. as taught by Chooi et al. because the process would is known in the art to prevent the copper diffusion.

Chung et al. teach a method of forming a silicon nitride (208) cap layer by using CVD process (see col. 3, lines 25-29 and figure 2A).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time the invention was made would depositing a silicon nitride layer as first barrier layer and silicon carbide as second barrier layer by a CVD method in Inohara et al.'s process as taught by

Chung et al. *because* depositing a silicon nitride layer by CVD process would provide a film layer having good thickness uniformity, high purity and good step coverage.

The thickness of the claim 4 are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted In re Aller 105 USPQ233, the selection of reaction parameters such as temperature and concentration would have been obvious:

“Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed “critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”

In re Aller 105 USPQ233, 255 (CCPA 1955). See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmscher* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934). Therefore, one of ordinary skill in the requisite art at the time the invention was made

would have used any thickness range suitable to the method in process of Inohara et al. in order to optimize the process.

Allowable Subject Matter

Claims 6-12 are allowed over the prior art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (703) 308-9439, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:30AM to 4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (703) 308-4940. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See MPEP 203.08).



Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN

